

NASA Solar System Exploration Research Virtual Institute

***Presentation to NASA/South Africa Workshop
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NASA
LUNAR
SCIENCE
INSTITUTE



NASA Lunar Science Institute initiated under a lunar Exploration-focused administration

- *Scientific Context for Exploration of the Moon* (2007, NRC) just released
- Constellation program focused on human lunar exploration
- Selected 7 teams, funded in 2009 for 4 years

New Administration created “flexible path” program for eventual human exploration of Mars

- Flexible path includes Moon, NEAs, Phobos and Deimos

NASA HQ broadened scope of NLSI to create SSERVI

- Keeps strategic alignment with administration direction

SSERVI has selected 9 long-duration teams

- 5 year agreements allow for – even necessitate – flexibility in scientific and technical approach
- Current teams will run through early 2019

Virtual institute structure created to foster

- Inter-team scientific relationships, particularly over cross-disciplinary boundaries
- International scientific relationships
- Support for community

SSERVI funded by two NASA organizations (science and human exploration) to look at common goals

- Basic principle: *Science enables exploration, exploration enables science*

- Conduct **basic and applied research** fundamental to lunar and planetary sciences **while advancing human exploration** of the solar system
- Conduct and catalyze **collaborative research** in lunar and planetary science, enabling **cross-disciplinary partnerships throughout the science and exploration communities**
- Provide **scientific, technical, and mission-relevant analyses** for appropriate NASA programs, planning, and space missions as requested by NASA
- Explore **innovative ways of using information technology for scientific collaboration** and information dissemination across geographic and contextual boundaries to stimulate inter- and cross-discipline research
- **Train the next generation** of scientific explorers through research opportunities, and encourage global education and public outreach (EPO) through formal education, informal programs, and participatory public events

- **Bill Bottke**, Southwest Research Institute. *“Institute for the Science of Exploration Targets: Origin, Evolution and Discovery” (ISET)*
- **Dan Britt**, University of Central Florida. *“Center for Lunar and Asteroid Surface Science” (CLASS)*
- **Ben Bussey**, Applied Physics Lab, Johns Hopkins University. *“Volatiles, Regolith and Thermal Investigations Consortium For Exploration and Science (VORTICES)”*
- **Bill Farrell**, Goddard Space Flight Center. *“Dynamic Response of Environments at Asteroids, the Moon, and moons of Mars (DREAM2)”*
- **Tim Glotch**, Stony Brook University. *“Remote, In Situ and Synchrotron Studies for Science and Exploration”*
- **Jennifer Heldmann**, Ames Research Center, *“Field Investigations to Enable Solar System Science & Exploration” (FinESSE)*
- **Mihaly Horanyi**, University of Colorado. *“Institute for Modeling Plasma, Atmospheres and Cosmic Dust (IMPACT)”*
- **David Kring**, Lunar and Planetary Institute. *“Inner Solar System Impact Processes”*
- **Carle Pieters**, Brown University. *“Evolution and Environment of Exploration Destinations: Science and Engineering Synergism (SEED)”*

					Britt		Heldmann							
	Heldmann				Farrell	Heldmann	Britt							
	Britt		Heldmann		Pieters	Britt	Farrell							
	Pieters		Pieters		Bussey	Pieters	Pieters		Heldmann					
Pieters	Bussey		Bussey		Botke	Bussey	Bussey		Farrell					
Botke	Botke		Botke		Britt	Kring	Kring		Pieters	Heldmann				
Kring	Kring		Kring		Farrell	Horanyi	Horanyi		Bussey	Bussey				
Horanyi	Glotch		Glotch		Horanyi	Glotch	Glotch		Glotch	Glotch				
Role of Target Body(s) in revealing the origin and evolution of the inner Solar System														
Target Body structure and composition														
Innovative observations that will advance our understanding of the fundamental physical laws, composition, and origins of the Universe														
Moon, NEA, and Martian moon investigations as windows into planetary differentiation processes														
Dust and plasma interactions on Target Body(s)														
Near-Earth asteroid characterization (including NEAs that are potential human destinations)														
Geotechnical properties (Moon, NEAs, Mars)														
Regolith of Target Bodies														
Radiation														
Volatiles (in its broad sense) and other potential resources on Target Body(s)														
In-Situ Resource Utilization (ISRU)/Prospecting (Moon, NEAs, Mars)														
Propulsion-induced ejecta (Moon, NEAs, Mars)														
Operations/Operability (all destinations, including transit)														
Human health and performance (all destinations, including transit)														

Science emphasis

Exploration emphasis (SKGs)

Asteroid Grand Challenge Seminar Series

<http://sservi.nasa.gov/events/> - access to archived & current events

- ✧ Feb 14: David Morrison (NASA Ames & SSERVI) “History of impacts research and planetary defense”
- ✧ Feb 28: Lindley Johnson (NASA HQ) “NASA's NEA programs”
- ✧ Mar 14: Paul Chodas (NEO Program Office at JPL) “NEA discovery, orbit calculation, and impact probability assessment”
- ✧ Mar 28: Alan Harris (JPL retired) “NEA populations and impact frequency”
- ✧ Apr 11: Dan Britt (University of Central Florida) “Physical properties of NEAs”
- ✧ Apr 25: David Kring (LPI) “Examples and consequences of NEA impacts”
- ✧ May 9: Tim Spahr (Minor Planet Center, CFA) “MPC and the International Warning Network”
- ✧ May 23: Dan Mazanek (NASA Langley) “NEA deflection strategies”

The NLSI established an active presence throughout the international community, resulting in:

- Seven international partnerships (next page)
 - Same partnerships continue with SSERVI
 - Open to new partnerships!
- Student exchange programs between international partners and domestic teams
 - Lunar field studies in Canada, U.S.
- Establishment of two NASA Postdoc Program Fellowships shared between domestic teams, one filled by an international student
- Participation and support in the ISECG
- NLSI helped establish Pan-European Lunar Sci. Consortium
 - First European Lunar Science Symposium 2011 Berlin; second planned for London May 2014;
 - Support annual EPSC lunar sessions
- Coordinated virtual participation from the global community in annual International Observe the Moon Night events
- Coordinated virtual participation in 2012 Noche de Las Estrellas star party events (Puerto Rico & Mexico City)
- Exploration Uplink events (including South Africa!)

Canada

PI: Gordon "Oz" Osinski,
University of Western Ontario
Partnership signed July 2008

**Israel**

PI: Shlomi Arnon
Ben-Gurion University at the Negev
Partnership signed in January 2010

**Korea**

PI: Im Yong-Taek,
Korean Institute for Advanced Science
Technology (KAIST)
Partnership signed November 2008

**Netherlands**

PI: Wim van Westrenen
VU University Amsterdam
Partnership signed August 2010



vrije Universiteit amsterdam

United Kingdom

PI: Mahesh Anand,
Open University
Partnership signed January 2009

**Germany**

PI: Ralf Jaumann
DLR
Partnership signed Dec. 2010

**Kingdom of Saudi Arabia**

PI: Abdulaziz Allothman
King Abdulaziz City for Science and
Technology (KACST)
Partnership signed in Dec. 2009



SSERVI will continue to provide strong support to:

- Pan-European Lunar Science Consortium
- European Lunar Symposium
- Student development through international internships (through LPI and others)
- International planetary science and other conferences (e.g., EPSC)
- Global Exploration Roadmap development



South Africa brings many assets to a potential partnership

- South African Astronomical Observatory (SAAO)

- Southern African Large Telescope (SALT)

- Square Kilometre Array (SKA)

- Departments of Astronomy at Universities

- Radio Astronomy and Astrophysics from the Moon

- Robotic maneuvering of telescopes such as Monet

Potential partnership could benefit asteroid detection, but also create lasting mutual benefits in research, student and community development

Past (NLSI) efforts toward establishing a partnership include:

- Attended the CAP 2010 meeting and workshop (part of IYA) in South Africa
- Met with Peter Martinez (Daou, Santiago) and Explored Partnership with NLSI
- Exploration Uplink sessions

Future could include:

- Asteroid detection
 - Operations and research
- Astronomy/Astrophysics
- Student development
 - Student Exchange
 - Field school (Barringer crater and Sudbury)
- Public Events
 - International Observe the Moon Night
- Exploration Uplink
- Joint efforts with IAU Office of Astronomy Development

SSERVI is hosting the first Exploration Science Forum July 21-23, 2014



- Expanded version of Lunar Science Forum, including NEAs, Phobos and Deimos
- Additional emphasis on topics included in Global Exploration Roadmap
- Abstracts open Feb. 18 – April 26 at
 - <http://sservi.nasa.gov>
- An in-person event
 - Last year's all-virtual Forum showed limits of virtual events
- Will continue
 - Focus Groups
 - Student & young researcher events



SSERVI continues to develop the community through research and other programs

SSERVI could be an ideal platform to assist in asteroid detection efforts, as well as to promote joint work by the U.S. and South African research communities

In addition, connect SA communities with other SSERVI partners

Bill Bottke, Southwest Research Institute. “*Institute for the Science of Exploration Targets: Origin, Evolution and Discovery*”

- Formation of terrestrial planets and asteroid belt, modeling of the Moon’s origin and Phobos/Deimos, history of NEAs and lunar bombardment, NEA origins, identification and characterization

Dan Britt, University of Central Florida. “*Center for Lunar and Asteroid Surface Science*”

- Studies of physical properties of regoliths: geotechnical properties, microgravity effects, impact ejecta, dynamics, hydration and weathering of NEAs, charging and mobilization of dust

Ben Bussey, Applied Physics Lab, Johns Hopkins University. “*Volatiles, Regolith and Thermal Investigations Consortium For Exploration and Science (VORTICES)*”

- Volatiles sources/sinks/processes and interaction with regoliths, evolution of regoliths on all target bodies, identification and exploitation of resources

Bill Farrell, Goddard Space Flight Center. *“Dynamic Response of Environments at Asteroids, the Moon, and moons of Mars (DREAM2)”*

- Plasma interactions, exospheres, Radiation of exposed materials, space weathering, solar storms/solar wind

Tim Glotch, Stony Brook University. *“Remote, In Situ and Synchrotron Studies for Science and Exploration”*

- Remote sensing of airless bodies, field operations and metrics for human exploration, reactivity and toxicity of regoliths, synchrotron analyses of samples, volcanics and impact crater analog research

Jennifer Heldmann, Ames Research Center, *“Field Investigations to Enable Solar System Science & Exploration”*

- Volcanics construct and magma chamber evolution, impact cratering mechanics and chronology, sampling for impact melt geology/geochemistry, volatile evolution and entrapment

Mihaly Horanyi, University of Colorado. *“Institute for Modeling Plasma, Atmospheres and Cosmic Dust (IMPACT)”*

- Small scale impact studies/regolith gardening, plasma charging and mobilization of dust, near surface plasma environments, new advancements on dust accelerator facility

David Kring, Lunar and Planetary Institute. *“Inner Solar System Impact Processes”*

- Impact history and processes, geochemistry of regoliths, age dating of regolith materials, NEA identification and characterization

Carle Pieters, Brown University. *“Evolution and Environment of Exploration Destinations: Science and Engineering Synergism (SEED)”*

- Thermal/chemical evolution of planetary bodies, origin and evolution of volatiles, remote sensing, space weathering of regoliths